



US009680162B2

(12) **United States Patent**
Kaminaka et al.

(10) **Patent No.:** **US 9,680,162 B2**
(45) **Date of Patent:** ***Jun. 13, 2017**

(54) **STAINLESS STEEL SHEET FOR A SEPARATOR FOR A SOLID POLYMER FUEL CELL AND A SOLID POLYMER FUEL CELL EMPLOYING THE SEPARATOR**

(75) Inventors: **Hideya Kaminaka**, Nishinomiya (JP); **Junko Imamura**, Amagasaki (JP); **Akira Seki**, Ashiya (JP); **Kouichi Takeuchi**, Chofu (JP)

(73) Assignee: **NIPPON STEEL & SUMITOMO METAL CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 713 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/080,937**

(22) Filed: **Apr. 6, 2011**

(65) **Prior Publication Data**

US 2011/0250522 A1 Oct. 13, 2011

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2009/067512, filed on Oct. 7, 2009.

(30) **Foreign Application Priority Data**

Oct. 7, 2008 (JP) 2008-260873
Nov. 14, 2008 (JP) 2008-292367
Oct. 7, 2009 (JP) 2009-233511

(51) **Int. Cl.**

H01M 8/021 (2016.01)
C22C 38/40 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **H01M 8/021** (2013.01); **C22C 38/40** (2013.01); **C22C 38/44** (2013.01);
(Continued)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,789,086 A * 8/1998 Ohmi C23C 8/14
148/280
6,420,070 B1 * 7/2002 Kasamatsu et al. 429/231.8
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1271027 10/2005
EP 1 094 535 4/2001

(Continued)

OTHER PUBLICATIONS

“Interlayer interactions in graphite and carbon nanotubes” by Palser et al, Phys. Chem. Chem. Phys. (1999) 1:4459-4464.*

(Continued)

Primary Examiner — Patrick Ryan

Assistant Examiner — Carmen Lyles-Irving

(74) *Attorney, Agent, or Firm* — Clark & Brody

(57) **ABSTRACT**

A stainless steel member for a separator of a solid polymer fuel cell has excellent cell properties with little deterioration in performance over long periods of operation without worsening of the corrosion resistance of a stainless steel separator. The stainless steel member has a stainless steel base metal, and a passive film and electrically conductive precipitates both provided on a surface of the stainless steel base metal. The electrically conductive precipitate penetrates the passive film and includes a substance originating from the stainless steel base metal. An electrically conductive layer comprising a nonmetallic electrically conductive substance is preferably provided on the surface of the passive film, and the electrically conductive layer is prefer-

(Continued)



FIG. 1

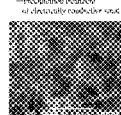


FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

